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# A retrospective radiological analysis of impacted mandibular third molar teeth and associated pathologies in a group of adult patients



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**Abstract**
Aim: Deciding on prophylactic extraction of impacted mandibular teeth can be challenging for clinicians. This study aimed to categorize the impacted mandibular teeth in a group of adult patients by two different classifications and determine their relationship with pathological changes.
Material and Methods: Preoperative panoramic radiographs of 1165 patients who had previously undergone removal of impacted mandibular third molar teeth were analyzed. Impacted teeth were categorized according to the Winter and Pell & Gregory classifications. Associated pathological findings included caries in adjacent molar teeth, pericoronal radiolucencies, possible cyst or tumor finding, and root resorption in adjacent molar teeth.
Results: The most common pathological findings associated with impacted mandibular third molars were pericoronal radiolucency (33.7%) and caries in second molars (24.9%), respectively. Distal decays were detected in second molars adjacent to those in mesioangular, Class I, and Level A positions. Radiolucency was found most frequently in those in vertical, Class II, and Level B positions ($p<0.001$). Cyst and tumor were found to be most common in those in horizontal, Class III, and Level C positions ($p <0.001$). Finally, resorption was found to be most common in impacted teeth in the horizontal and Class II positions ($p<0.001$).
Discussion:. Considering the positions of impacted mandibular third molars may provide an estimate of the possible future pathologies. This study may provide dentists and oral and maxillofacial surgeons with guiding findings in deciding on prophylactic removal of impacted teeth.

**Keywords**
Impacted Teeth, Retrospective, Pathological Changes, Mandibular Third Molars

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## Introduction

Impacted teeth are shown as those that do not erupt in the expected time, which is accepted as an anomaly. Impacted teeth can be located far from the expected eruption area, or they can be completely or partially covered with mucoperiosteum and bone [1, 2]. Mandibular third molar teeth are the most frequently impacted teeth among others [3]. Systemic or local factors may cause permanent teeth to remain impacted. Systemic causes include genetic causes, malnutrition, and specific syndromes, such as Cleidocranial dysostosis, Gardner syndrome, and Gorlin-Sedano syndrome, and Yunis-Varon syndrome, while local causes are characterized by insufficient dental arch, compact bone on the tooth, and sizes and positions of adjacent teeth [4-6]. Impacted mandibular third molars are often asymptomatic unless irritating factors cause the development of symptoms [7]. However, impacted teeth may cause various odontogenic tumors and complaints such as pain, caries, pericoronitis, resorption of adjacent roots, tooth cysts, and caries in adjacent second molars [8, 9]. Besides, prophylactic removal of non-pathological impacted third molars is widely practiced, but it is controversial [10].

Dental panoramic imaging in dentistry is a two-dimensional imaging method based on the tomographic technique, which has been widely used since the 1950s. Its resolution is poorer and less detailed than intraoral radiographs. However, it is a useful diagnostic method for imaging the teeth, jawbone, and surrounding anatomical structures in the jaw-face region [11]. In the presence of impacted third molars, dental panoramic radiography, also known as orthopantomography (OPG), may help determine eruption patterns, positions, and inclinations of teeth and the relationship with their neighboring teeth and structures [12].

The Pell & Gregory classification, one of the methods used in the classification of impacted teeth, classifies wisdom teeth by the ramus plane and impaction depth [6,13]. Another classification, the Winter classification, considers the inclination of the impacted teeth to the long axis of second molars [6,14].

It was thought that the evaluation of teeth positions and associated pathologies in patients undergoing removal of impacted mandibular teeth would provide valuable contributions to dentists and oral and maxillofacial surgeons while deciding on prophylactic tooth extraction.

Ultimately, it was aimed in the present study to categorize the impacted mandibular teeth by two different classifications and investigate whether there was a relationship between them and pathological changes.

## Material and Methods

In this retrospective study, preoperative panoramic radiographs of the patients who underwent tooth extraction were reviewed. The study was granted with the relevant ethical approval by Sütçü İmam University, School of Medicine, Clinical Research Ethics Committee (2019/11). The research was carried out on the radiographs of patients aged 20 years and over with partially or fully impacted mandibular third molas and with a second molar tooth. However, radiographs of wisdom teeth that did not complete root development, patients under 20 years of age, and radiographs with low image quality were excluded from the study.

All radiographs were taken by single personnel on the same device, considering the ideal shooting procedures, with an exposure time of 66 kV, 10.0 mA 16 sec. in the GENDEX GDP-700 device.

Patient age and gender data were extracted from a digital patient automation. Impacted teeth on panoramic radiographs were categorized using the Winter and Pell & Gregory classifications. In the Pell and Gregory classification, impacted mandibular teeth are grouped into Class I, Class II, and Class III by the mandibular ramus plane and Level A, Level B, and Level C by the occlusal plane, respectively.

On the other hand, according to the Winter classification, impacted teeth are grouped as mesioangular, distoangular, vertical, horizontal, and other (buccal-lingual, transverse) [6, 13, 14].

In this study, radiographic lesions were categorized as follows:

1-Caries in adjacent teeth,

2-Pericoronal radiolucencies (>2.5mm.)

3-Possible cyst or tumor finding

4-Root resorption in adjacent teeth (Figure 1-3).

The radiographs were analyzed by an oral and maxillofacial radiologist with four years of experience.

### *Statistical Analyses*

Jamovi (Version 1.0.4) software was used for all statistical analyses. Descriptive statistics with Pearson's x2 test were given to reveal associations between demographic characteristics, classifications of third molars and caries, radiolucency, cyst-tumor, and resorption. The probability level for statistical significance was set at $p = 0.05$.

## Results

In this study, preoperative panoramic radiographs of 1165 (780 females, 385 males) patients with impacted mandibular teeth were reviewed. The age distribution of the patients is given in Table 1. A total of 1165 surgically removed teeth (516 no. 38 and 649 no. 48) were included in the study. In the study, impacted mandibular teeth were found to be most frequent in males and in the 30-40 age group. Besides, there were pathological findings in 67.1% of the removed impacted teeth (Table 1). The most common radiographic finding associated with impacted mandibular third molars was pericoronal radiolucency (33.7%), which was followed by adjacent tooth decay (24.9%) (Table 1).

According to the Winter classification, there were 509 teeth (43.6%) in mesioangular position, while only ten teeth (0.85%) were in other positions (Table 1). By the depth of impaction in the Pell & Gregory classification, Level B was determined to be the most frequent impaction in the teeth (41.7%), and according to the relationship with the ramus plane, the teeth were most commonly in Class II position (38.5%) (Table 1).

A significant difference was found between age and cyst-tumor pathological findings ($p<0.001$). Patients aged 30-40 years had more cyst-tumor findings. The incidence of tooth decay and cyst-tumor in second molars was higher in males ($p<0.001$). Decays were observed to be most frequent in second molars when impacted teeth were in mesio-angular position (according to the Winter classification) and in Class II and Level A positions (according to the Pell & Gregory classification)

**Table 1.** Descriptive analysis of the patients' demographic and radiographic characteristics (n=1165)

| Demographic and radiographic characteristics | n | % |
|---|---|---|
| Age | | |
| 20< x<30 | 257 | 22.06 |
| 30< x<40 | 614 | 52.70 |
| 40< x< 50 | 121 | 10.38 |
| 50< x | 173 | 14.84 |
| Gender | | |
| Male | 385 | 33 |
| Female | 780 | 67 |
| Tooth number | | |
| 38 | 516 | 44.3 |
| 48 | 649 | 55.7 |
| Winter | | |
| Vertical | 310 | 26.6 |
| Mesioangular | 509 | 43.6 |
| Distoangular | 209 | 17.9 |
| Horizontal | 127 | 10.9 |
| Digger (Buccal, Lingual, Transvers) | 10 | 0.85 |
| Pell& Gregory | | |
| Level A | 239 | 20.5 |
| Level B | 486 | 41.7 |
| Level C | 440 | 37.8 |
| Relationship with ramus | | |
| Class 1 | 395 | 33.9 |
| Class 2 | 449 | 38.5 |
| Class 3 | 321 | 27.6 |
| Caries | | |
| Available | 290 | 24.9 |
| None | 875 | 75.1 |
| Radiolucency | | |
| Available | 393 | 33.7 |
| None | 772 | 66.3 |
| Cyst-Tumor | | |
| Available | 84 | 7.2 |
| None | 1081 | 92.8 |
| Resorption | | |
| Available | 15 | 1.3 |
| None | 1150 | 98.7 |

(p<0.001). By the Winter classification, radiolucency was found to be most frequent in teeth in the vertical position, followed by the distoangular position. It was the most frequent in teeth in Class II and Level B positions according to the Pell & Gregory classification (p<0.001).

Cyst-tumor was the most prevalent finding in teeth in the horizontal position according to the Winter classification, while it was most common in teeth in Class III and Level C positions according to the Pell & Gregory classification (p<0.001). Horizontal (the Winter Classification) and Class II (the Pell & Gregory classification) were the most prevalent positions where root resorption in second molars was detected (p<0.001). Table 2 displays the comparisons of the pathological findings by demographic characteristics and impaction classifications for impacted mandibular third molars.

**Figure 1.** Tooth no. 38 in the mesioangular position and decay in the distal of the second molar

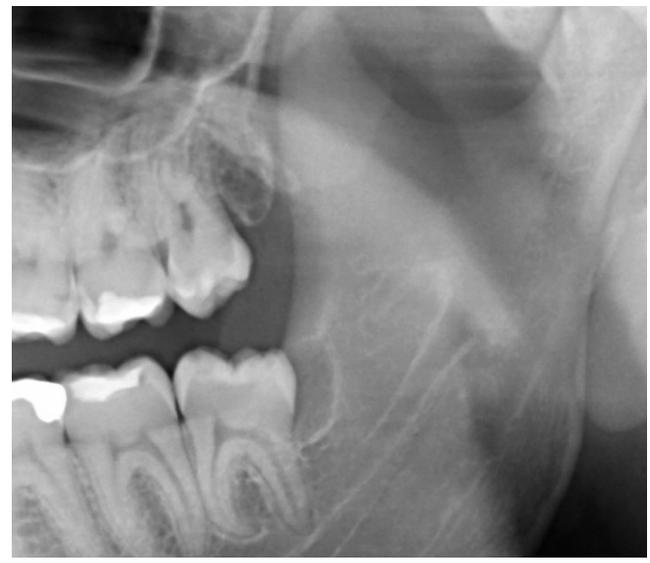

**Figure 2.** Tooth no. 38 in the vertical position and pericoronal radiolucency

**Figure 3.** Tooth no 38 in the horizontal position, possible cyst & tumor finding, and root resorption in the second molar

**Table 2.** Comparison of pathological findings by the patients' demographic characteristics and impaction classifications of mandibular third molars (% within a row; Chi-square p-value)

| Factors | Caries | | | Radiolucency | | | Cyst-Tumor | | | Resorption | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Available | None | p-value | Available | None | p-value | Available | None | p-value | Available | None | p-value |
| Age | | | | | | | | | | | | |
| 20< x<30 | 28.0% | 72.0% | | 34.2% | 65.8% | | 1.7% | 98.3% | | 1.2% | 98.8% | |
| 30< x<40 | 23.0% | 77.0% | 0.302 | 32.7% | 67.3% | 0.113 | 12.8% | 87.2% | <0.001 | 0.8% | 99.2% | 0.273 |
| 40< x< 50 | 28.9% | 71.1% | | 43.0% | 57.0% | | 7.5% | 92.587.2% | | 2.5% | 97.5% | |
| 50< x | 24.3% | 75.7% | | 30.1% | 69.9% | | 1.7% | 98.3% | | 2.3% | 97.7% | |
| Gender | | | | | | | | | | | | |
| Male | 34.0% | 66.0% | <0.001 | 35.1% | 64.9% | 0.500 | 21.8% | 78.2% | <0.001 | 2.1% | 97.9% | 0.093 |
| Female | 20.4% | 79.6% | | 33.1% | 66.9% | | 0% | 100% | | 0.9% | 99.1% | |
| Tooth number | | | | | | | | | | | | |
| 38 | 23.8% | 76.2% | 0.458 | 63.6% | 36.4% | 0.082 | 1.4% | 98.6% | <0.001 | 1.6% | 98.4% | 0.478 |
| 48 | 25.7% | 74.3% | | 68.4% | 31.6% | | 11.9% | 88.1% | | 1.1% | 98.9% | |
| Winter | | | | | | | | | | | | |
| Vertical | 0.0% | 100% | | 70.5% | 25.5% | | 15.8% | 84.2% | | 1.6% | 98.4% | |
| Mesioangular | 54.5% | 45.5% | | 22.7% | 77.3% | | 0% | 100% | | 0.6% | 99.4% | |
| Distoangular | 0.0% | 100% | <0.001 | 48,40% | 51,60% | <0.001 | 0% | 100% | <0.001 | 0% | 100% | <0.001 |
| Horizontal | 5.5% | 94.5% | | 5.5% | 94.5% | | 27.6% | 72.4% | | 5.5% | 94.5% | |
| Other | 0.0% | 0.0% | | 0.0% | 0.0% | | 0.0% | 0.0% | | 0.0% | 0.0% | |
| Pell&Gregory | | | | | | | | | | | | |
| Level A | 46.9% | 53.1% | | 2.9% | 97.1% | | 0% | 100% | | 1.7% | 98.3% | |
| Level B | 36.6% | 63.4% | <0.001 | 72.8% | 27.2% | <0.001 | 0% | 100% | <0.001 | 0.4% | 99.6% | 0.074 |
| Level C | 0% | 100% | | 7.3% | 92.7% | | 19.1% | 80.9% | | 2.0% | 98.0% | |
| Relationship with ramus | | | | | | | | | | | | |
| Class 1 | 10.0% | 90.0% | | 28.1% | 71.9% | | 1.8% | 98.2% | | 0% | 100% | |
| Class 2 | 62.0% | 38.0% | <0.001 | 62.8% | 37.2% | <0.001 | 0% | 100% | <0.001 | 3.3% | 96.7% | <0.001 |
| Class 3 | 0% | 100% | | 0% | 100% | | 24.0% | 76.0% | | 0.6% | 99.4% | |

## Discussion

Considering the age profile of the patients, it was found that the removal operation was done mostly between the ages of 30-40 years and 20-30 years, respectively. Supporting our findings, the relevant literature suggests that the most active years for the dental surgery on impacted third molars are between 20 and 40 years of age [15].

The preoperative radiographs of the patients showed that the most prevalent pathologies were pericoronal radiolucency (33.7%) and distal decays of adjacent second molars (24.9%). In a similar study, Polat et al. determined that the most common pathologies associated with impacted mandibular teeth were caries in adjacent teeth (12%) and distal radiolucency (9.7%) [16]. The high frequency of pathology in this study may be due to the fact that the sample consisted of patients who underwent tooth extraction.

In the study, it was concluded that impacted teeth were most frequent in mesio-angular position (43.6%) and vertical position (26.6%), according to the Winter classification. In a study conducted in Pakistan, Nazir et al. reported that impacted teeth were found mostly in a mesio-angular position followed by vertical, distoangular, and horizontal positions [17]. It was also found in the study by Mollaoğlu et al. that the mesioangular position was the most prevalent position for impacted mandibular third molars [18]. Again, Msagati et al. found 738 (76%) of the impacted mandibular third molars were in the mesioangular position, 87 (8.9%) were in the horizontal position, and 69 (7.1%) were in the distoangular position [4].

On the other hand, according to the impaction depth in the Pell & Gregory classification, the impacted teeth in the radiographs were mostly found in Level B (41.7%) position. By the relationship with the ramus, they appeared most frequently in Class II (38.5%) position. Nazir et al. also detected impacted teeth to be the most frequent in Class II position, followed by Class I and Class III positions. Unlike our study, their study found that the most common positions were Level A, followed by Level B and C, according to the impaction depth position [17]. In the study of Blondeau et al. in Canada, the most prevalent position for mandibular third molars was Level B [19].

Yılmaz et al. reported that the positional changes in impacted teeth might vary depending on genetic differences and the sample selection [9]. The sample of this study consisted of a group of patients who underwent an impacted tooth removal operation.

Much of the thinking in the literature agrees that a period of 2-13 years is required for the development of cysts associated with impacted mandibular third molars [20]. The longer a tooth is impacted, the higher the risk occurs for developing cysts and tumors [21]. In this study, it was determined that cyst-tumor findings were more common in patients aged 30-40 years. It was also detected that cyst-tumor finding was the most prevalent in teeth in the horizontal (the Winter classification), Class III, and Level C (the Pell & Gregory classification) positions ($p < 0.001$). Moreover, males were at more risk of developing cyst-tumor ($p < 0.001$). Similar to our study, Nazir et al. stated that cyst-tumor findings were most frequently associated with

Level C position [17]. Vigneswaran et al. examined the incidence of cyst-tumor associated with impacted mandibular third molars, and reported that the highest pathology incidence was in males. However, compared to our study, the incidence of cyst tumors increased at younger ages. Besides, it was stated that the tooth position associated with cyst-tumor was vertical and distoangular positions, according to the Winter classification [22].

It was discovered that the incidence of distal tooth decays in second molar teeth were most prevalent when impacted teeth were in the mesioangular (the Winter classification), Level A, and Class II (the Pell & Gregory classification) positions ($p < 0.001$). This finding was followed by the Level B and Class-I positions ($p < 0.001$). In a recent study, in parallel with this study, second molar decays were most prevalent when impacted molars were in Level A and Class II positions. This situation was explained by the fact that teeth in Level A and Class II positions are at the highest level in the mouth; therefore, they are exposed to the oral cavity. Also, why second molars are not decayed when impacted teeth in Level C position is because these teeth are not exposed to the oral cavity since they are fully impacted. On the other hand, partial eruption of the tooth in the mesioangular position is reported to cause distal caries in the mandibular second molar due to plaque accumulation [23].

The incidence of radiolucency was significantly higher in those in vertical (the Winter classification), Class II, and Level B (the Pell & Gregory classification) positions ($p < 0.001$). Similar to this study, Polat et al. evaluated pathologies associated with impacted mandibular teeth and reported frequent radiolucency in the distal parts of impacted teeth in the disto-angular and vertical positions [16]. Nazir et al. stated that radiolucency was seen most frequently in teeth in Class II, Level A, and Level B positions. They explained this situation by the fact that the teeth in Level A, Level B, and Class II positions were partially impacted and partially covered with soft tissue [17].

The incidence of root resorption in adjacent teeth significantly differed by Class II and horizontal positions ($p < 0.001$). However, no significant difference was found between root resorption in adjacent teeth and impacted tooth depth in this study. Subedi et al. reported that root resorption in adjacent teeth was most common when impacted teeth were in Level B and Class II positions [24]. Oenning et al. reported that the possibility of root resorption in adjacent teeth increased when impacted mandibular teeth were in mesioangular and horizontal positions [25].

***Conclusion:*** In the study, it was found that impacted mandibular third molars were associated with some pathologies by their positions. Considering the positions of impacted mandibular third molars in preoperative panoramic radiographs may give an idea about the pathologies that may develop in the future. This study may suggest guiding findings for dentists and oral and maxillofacial surgeons in deciding on prophylactic removal of impacted teeth.

***Limitations:*** The radiographs in the study were analyzed by only one expert. The reliability of the further studies will be contributed when conducted with at least two independent and blind observers. On the other hand, the findings were only radiological preliminary diagnoses, not confirmed by any histopathological examination, and the clinical symptoms of the patients were unknown.

***Scientific Responsibility Statement***

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

***Animal and human rights statement***

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

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